CLAIMS

<u>**What is Claimed is:**</u>

5   1. An adaptive filter, comprising:

a filter input for receiving a first signal;

a filter output for outputting a second signal based upon said first signal to a summation device;

an error input for receiving an error input signal generated by a comparison of the second signal against a third signal; and

10   a plurality of first coefficients having a plurality of poles and a plurality of zeroes wherein said first coefficients are determined by deriving a finite impulse response (FIR) filter having a predetermined number of second coefficients, obtaining convergence of said second coefficients, converting said FIR filter into an infinite impulse response (IIR) filter, and updating

15   the zeroes of said first coefficients based upon said error input signal while concurrently maintaining the poles of said first coefficients in a fixed state.

2. The adaptive filter of claim 1 wherein convergence of said second coefficients is achieved using a Least-Mean-Square approach.

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3. The adaptive filter of claim 1 wherein updating the zeroes of said first coefficients is achieved using a Least Means Square approach.

4. A method for filtering a signal, comprising the steps of:

25   deriving a plurality of first coefficients of an infinite impulse response (IIR) filter wherein said first coefficients have a plurality of poles and a plurality of zeroes and are determined by deriving a filter having a predetermined number of second coefficients, obtaining convergence of the filter, and converting said filter into the IIR filter;

receiving a first signal;

outputting a second signal wherein the second signal is a function of the first coefficients and the first signal;

receiving an error input signal generated by a comparison of the second signal against a third signal; and

5   updating the zeroes of said first coefficients based upon said error input signal and not updating the poles of said first coefficients.

5.   The method of claim 4 further comprising the steps of:

monitoring the error input signal; and

10   if the error input signal exceeds a predetermined threshold, re-deriving the first coefficients by re-determining the predetermined number of second coefficients of the filter, obtaining convergence of the filter, and re-converting said filter into the IIR filter.

6.   The adaptive filter of claim 4 wherein convergence of said second coefficients is
15   achieved using a Least-Mean-Square approach.

7.   An echo cancellation system for canceling echo within a second signal generated by the
       transmittal of a first signal through a cross-coupling pathway, comprising:

       a summation device for summing a third signal and the second signal to produce an error
20   signal; and

       an adaptive filter comprising a filter input for receiving the first signal, a filter output for outputting the third signal based upon said first signal to the summation device, an error input for receiving the error signal, and a plurality of first coefficients having a plurality of poles and a plurality of zeroes wherein the zeroes of said first coefficients are updated based upon said error
25   signal and wherein the poles of said first coefficients are maintained in a substantially fixed state.

8.   The echo cancellation system of claim 7 wherein the first coefficients are initially
       determined by deriving a filter having a predetermined number of second coefficients,
       obtaining convergence of said second coefficients, dividing said second coefficients into

a first set of second coefficients and a second set of second coefficients, and converting said second set of second coefficients into the first coefficients.

9. A method for canceling an echo wherein the echo is generated by transmitting a first signal through an echo-causing system, comprising the steps of:

deriving coefficients of an infinite impulse response (IIR) filter wherein said coefficients have a plurality of zeroes and are determined by deriving a finite impulse response (FIR) filter, obtaining convergence of the FIR filter, and converting said filter into the IIR filter;

receiving a first signal;

outputting a second signal wherein the second signal is a function of the coefficients and the first signal;

receiving an error signal generated by a comparison of the second signal against a third signal; and

updating only the zeroes of said coefficients based upon said error signal.

10. A gateway operative to transmit signals between a circuit switched network and a packet based network, comprising:

a plurality of digital to analog encoders and decoders; and

an echo cancellation device wherein said device comprises a summation device for summing a first signal and a second signal to produce an error signal and an adaptive filter comprising a filter input for receiving a third signal, a filter output for outputting the second signal based upon said third signal to the summation device, an error input for receiving the error signal, and coefficients having a plurality of zeroes wherein only the zeroes of said coefficients are updated based upon said error signal.

11. A multi-channel echo cancellation system for substantially reducing the presence of a plurality of undesired frequencies in a plurality of first signals, wherein said first signals are transmitted across a plurality of channels, comprising:

at least one summation device operative in each of said channels; and

at least one adaptive filter operative in each of said channels wherein each of said adaptive filters has a filter input for receiving a second signal, a filter output for outputting a third signal based upon said second signal to the summation device, an error input for receiving an error signal generated by a comparison of the first signal against the third signal, and a

5   plurality of first coefficients having a plurality of zeroes wherein said first coefficients are determined by deriving a filter having a predetermined number of second coefficients, obtaining convergence of said second coefficients, converting said filter into an infinite impulse response (IIR) filter to yield the first coefficients, and updating only the zeroes of the first coefficients based upon said error signal.

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12. An adaptive filter, comprising:

     a filter input for receiving a first signal;

     a filter output for outputting a second signal based upon said first signal to a summation device;

15   an error input for receiving an error signal generated by a comparison of the second signal against a third signal; and

     a plurality of first coefficients having a plurality of poles and a plurality of zeroes wherein the zeroes of said first coefficients are updated based upon said error signal and wherein the poles of said first coefficients are maintained in a substantially fixed state.

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13. The adaptive filter of claim 12 wherein said first coefficients are initially determined by deriving a filter having a predetermined number of second coefficients, obtaining convergence of said second coefficients, dividing said second coefficients into a first set of second coefficients and a second set of second coefficients, and converting said second

25   set of second coefficients into the first coefficients.

14. An adaptive filter, comprising:

     a finite impulse response (FIR) filter having a plurality of first coefficients wherein said first coefficients are determined by deriving a FIR filter having a predetermined number of

30   second coefficients, obtaining convergence of said second coefficients, dividing said second

coefficients into a first set of second coefficients and a second set of second \coefficients, and adopting the first set of second coefficients as the first coefficients; and

an infinite impulse response (IIR) filter having an input for receiving a first signal, an output for outputting a second signal based upon said first signal, an error input for receiving an

5 error input signal generated by a comparison of the second signal against a third signal, and a plurality of third coefficients wherein said third coefficients have a plurality of poles and a plurality of zeroes and are derived from said second set of second coefficients.

15. The adaptive filter of claim 14 wherein the zeroes of the third coefficients are updated

10 based upon said error input signal.

16. The adaptive filter of claim 14 wherein the poles of the third coefficients are fixed.

17. A channel equalizing system for equalizing signals received in at least one channel,

15 comprising:

an adaptive filter having a filter input for receiving a first signal, a filter output for outputting a second signal based upon said first signal, an error input for receiving an error signal, and a plurality of first coefficients having a plurality of poles and a plurality of zeroes wherein the zeroes of said first coefficients are updated based upon said error signal and wherein

20 the poles of said first coefficients are maintained in a substantially fixed state.

18. A method for equalizing a channel, comprising the steps of:

deriving coefficients of an infinite impulse response (IIR) filter wherein said coefficients have a plurality of zeroes and are determined by deriving a finite impulse response (FIR) filter,

25 obtaining convergence of the FIR filter, and converting said filter into the IIR filter;

receiving a first signal;

outputting a second signal wherein the second signal is a function of the coefficients and the first signal;

receiving an error signal; and

30 updating only the zeroes of said coefficients based upon said error signal.